

- d. Descriptive documentation of optional barriers specified for electrical insulation and isolation.
 - e. Utility company's metering provisions with indication of approval by utility company.
 - f. Mimic-bus diagram.
 - g. UL listing for series rating of installed devices.
 - h. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:
 1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event."
 3. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event."
 4. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 5. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
- E. Field Test Reports: Submit written test reports and include the following:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Manufacturer's field service report.
- G. Updated mimic-bus diagram reflecting field changes after final switchboard load connections have been made, for record.
- H. Maintenance Data: For switchboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," include the following:
 1. Routine maintenance requirements for switchboards and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA PB 2.
- D. Comply with NFPA 70.
- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards, including clearances between switchboards, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in sections of lengths that can be moved past obstructions in delivery path.
- B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchboards; install electric heating (250-W per section) to prevent condensation.
- D. Handle switchboards according to NEMA PB 2.1.

1.7 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, existing equipment doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Government not less than 14 days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
 2. Indicate method of providing temporary utilities.
 3. Proceed with utility interruptions only after receiving Government's written authorizations.
- C. Environmental Limitations: Rate equipment for continuous operation under the following, unless otherwise indicated:
1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 2. Altitude: Not exceeding 6600 feet (2000 m).
- D. Service Conditions: NEMA PB2, usual service conditions, as follows:
1. Altitude not exceeding 6600 feet (2000 m).
 2. Ambient temperatures within limits specified.

1.8 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

PART 2 - PRODUCT

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Corp.; Cutler-Hammer Products.
 2. General Electric Co.; Electrical Distribution & Control Div.
 3. Siemens Energy & Automation, Inc.
 4. Square D Co.

2.2 MANUFACTURED UNITS

- A. Front-Connected, Front-Accessible Switchboard: Panel-mounted Fixed, individually mounted main device, panel-mounted branches, and sections rear aligned.
- B. Front- and Side-Accessible Switchboard: Fixed, individually mounted main device, panel-mounted branches, and sections rear aligned.

C. Front- and Rear-Accessible Switchboard: Front and rear aligned, with features as follows:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel and fixed mounted.

D. Nominal System Voltage: 208 Y/120 V.

E. Main-Bus Continuous:

1. As indicated.

2.3 FABRICATION AND FEATURES

A. Enclosure: Steel:

B. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

C. Barriers: Between adjacent switchboard sections.

D. Insulation and isolation for main and vertical buses of feeder sections.

E. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

F. Removable, Hinged Rear Doors and Compartment Covers: Secured by captive thumb screws, for access to rear interior of switchboard.

G. Hinged Front Panels: Allow access to circuit-breaker, metering, accessory, and blank compartments.

H. Pull Box on Top of Switchboard: Include the following features:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Set back from front to clear circuit-breaker removal mechanism.
3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
6. Connect existing wireway to new switchboard.

I. Buses and Connections: Three phase, four wire, unless otherwise indicated. Include the following features:

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.

2. Load Terminals: Insulated, rigidly braced, silver-plated, copper runback bus extensions equipped with pressure connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full ampere rating of circuit-breaker position.
 3. Ground Bus: 1/4-by-2-inch (6-by-50-mm) minimum size, drawn-temper copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 4. Contact Surfaces of Buses: Silver plated.
 5. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
 7. Neutral Buses: 100 percent of the ampacity of the phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus is braced.
- J. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- K. Bus-Bar Insulation: Factory-applied, flame-retardant, 105 deg C minimum tape wrapping of individual bus bars or flame-retardant, spray-applied insulation of same temperature rating.

2.4 TVSS DEVICES

- A. IEEE C62.41, integrally mounted, plug-in style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.
- B. Minimum single-impulse current rating shall be as follows:
1. Line to Neutral: 100,000 A.
 2. Line to Ground: 100,000 A.
 3. Neutral to Ground: 50,000 A.
- C. Protection modes shall be as follows:
1. Line to neutral.
 2. Line to ground.
 3. Neutral to ground.
- D. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.
- E. Category C combination wave clamping voltage shall not exceed 600 V, line to neutral and line to ground on 120/208 V.
- F. UL 1449 clamping levels shall not exceed 400 V, line to neutral and line to ground on 120/208 V systems 800 V, line to neutral and line to ground on 277/480 V systems.

- G. Withstand Capabilities: 3000 Category C surges with less than 5 percent change in clamping voltage.
- H. Accessories shall include the following:
 - 1. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.
 - 2. Audible alarm activated on failure of any surge diversion module.
 - 3. Six-digit transient-counter set to totalize transient surges that deviate from the sine-wave envelope by more than 125 V.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Ground-Fault Protection: Integrally mounted Remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - 4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system.
 - 5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 to 75 percent of rated voltage.
 - 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

7. Auxiliary Switch: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

C. Enclosed, Insulated-Case Circuit Breaker: Fully rated, encased-power circuit breaker with interrupting capacity rating to meet available fault current.

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.2 EXAMINATION

- A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Support switchboards on concrete bases, 4-inch (100-mm) nominal thickness.
- C. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

- F. Install switchboard to allow for connection to existing wiring.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16.
- B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.5 CONNECTIONS

- A. Install equipment grounding connections for switchboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing Agency: Owner will engage a qualified independent testing agency to perform specified testing.
- C. Testing: After installing switchboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front front and rear panels so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

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3. Record of Infrared Scanning: Prepare a certified report that identifies switchboards checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.8 CLEANING

- A. On completion of installation, inspect interior and exterior of switchboards. Remove paint spatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 16441

SECTION 16442 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Distribution panelboards.
 - 3. Transient voltage surge suppressor panelboards.
- B. Related Sections include the following:
 - 1. Division 16 Section "Seismic Controls for Electrical Work."

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.
- F. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.

- b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. UL listing for series rating of installed devices.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:
 1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event."
 3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
- E. Field Test Reports: Submit written test reports and include the following:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- G. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, existing conduits and equipment and encumbrances to workspace clearance requirements.

1.7 EXTRA MATERIALS

- A. Keys: Six spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Control Div.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D Co.

2.2 FABRICATION AND FEATURES

- A. Enclosures: As indicated-mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.

- B. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- C. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- D. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- E. Bus: Hard-drawn copper, 98 percent conductivity.
- F. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- H. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- I. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- J. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
- K. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- L. Split Bus: Vertical buses divided into individual vertical sections.
- M. Gutter Barrier: Arrange to isolate individual panel sections.
- N. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISTRIBUTION PANELBOARDS

- A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
- B. Main Overcurrent Protective Devices: Circuit breaker.
- C. Branch overcurrent protective devices shall be one of the following:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. GFCI Circuit Breakers: Single- and two-pole configurations with 5 30-mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - 4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 75 percent of rated voltage.
 - 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - 6. Auxiliary Switch: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - 7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - 8. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

2.7 CONTROLLERS

- A. Motor Controllers: NEMA ICS 2, Class A combination controller equipped for panelboard mounting and including the following accessories:
 - 1. Individual control-power transformers.
 - 2. Fuses for control-power transformers.
 - 3. Bimetallic-element overload relay.
 - 4. Melting-alloy overload relay.
 - 5. Indicating lights.
 - 6. Seal-in contact.
 - 7. Convertible auxiliary contacts.
 - 8. Push buttons.
 - 9. Selector switches.
- B. Contactors: NEMA ICS 2, Class A combination controller equipped for panelboard mounting and including the following accessories:
 - 1. Individual control-power transformers.
 - 2. Fuses for control-power transformers.
 - 3. Indicating lights.
 - 4. Seal-in contact.
 - 5. Push buttons.
 - 6. Selector switches.
- C. Controller Disconnect Switches: Adjustable instantaneous-trip circuit breaker integrally mounted to and interlocked with controller.
 - 1. Auxiliary Contacts: Integral with disconnect switches to de-energize external control-power source.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held general-purpose controller.
 - 1. Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. Control-Power Source: 120-V branch circuit.

2.8 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: To test functions of solid-state trip devices without removal from panelboard.
- C. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work."
- C. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- D. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- E. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- F. Install filler plates in unused spaces.
- G. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- H. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."
- B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

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3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 16442

SECTION 16511 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, lamps, ballasts, emergency lighting units, and accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
 - 1. Dimensions of fixtures.
 - 2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
 - 3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - 4. Emergency lighting unit battery and charger.
 - 5. Fluorescent and high-intensity-discharge ballasts.
 - 6. Types of lamps.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
 - 1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
- C. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.
- D. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.

- C. FM Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM.
- D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

- A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty for Batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Special Warranty Period for Batteries: Manufacturer's standard, but not less than 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for last nine years.
- C. Special Warranties for Fluorescent Ballasts: Written warranty, executed by manufacturer agreeing to replace fluorescent ballasts that fail in materials or workmanship within specified warranty period.
 - 1. Special Warranty Period for Electronic Ballasts: Five years from date of manufacture, but not less than four years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Lighting Fixture Schedule.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
- D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
 - 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
 - 2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

2.3 FLUORESCENT LAMP BALLASTS

- A. General Requirements: Unless otherwise indicated, features include the following:
 - 1. Designed for type and quantity of lamps indicated at full light output.
 - 2. Total Harmonic Distortion Rating: Less than 10 percent.
 - 3. Sound Rating: A.
- B. Electronic Ballasts for Linear Lamps: Unless otherwise indicated, features include the following, besides those in "General Requirements" Paragraph above:
 - 1. Certified Ballast Manufacturer Certification: Indicated by label.
 - 2. Encapsulation: Without voids in potting compound.
 - 3. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
- C. Ballasts for Compact Lamps in Recessed Fixtures: Unless otherwise indicated, additional features include the following:
 - 1. Type: Electronic or electromagnetic, fully encapsulated in potting compound.
 - 2. Power Factor: 90 percent, minimum.
 - 3. Operating Frequency: 20 kHz or higher.
 - 4. Flicker: Less than 5 percent.
 - 5. Lamp Current Crest Factor: Less than 1.7.
 - 6. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
 - 7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

- D. Ballasts for Compact Lamps in Nonrecessed Fixtures: Unless otherwise indicated, additional features include the following:
1. Power Factor: 90 percent, minimum.
 2. Ballast Coil Temperature: 65 deg C, maximum.
 3. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
 4. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.4 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

- A. General: Comply with ANSI C82.4. Unless otherwise indicated, features include the following:
1. Type: Constant wattage autotransformer or regulating high-power-factor type, unless otherwise indicated.
 2. Operating Voltage: Match system voltage.
 3. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single lamp ballasts.
 4. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
 5. Open-circuit operation that will not reduce average life.
 6. Auxiliary, Instant-on, Quartz System: Automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. Automatically turns quartz lamp off when high-intensity-discharge lamp reaches approximately 60 percent light output.
- B. Encapsulation: Manufacturer's standard epoxy-encapsulated model designed to minimize audible fixture noise.
- C. High-Pressure Sodium Ballasts: Equip with a solid-state igniter/starter having an average life in pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 deg C.
1. Instant Restrike Device: Solid-state, potted module, mounted inside high-pressure sodium fixture and compatible with high-pressure sodium lamps, ballasts, and sockets up to 150 W.
 - a. Restrike Range: 105- to 130-V ac.
 - b. Maximum Voltage: 250-V peak or 150-V ac RMS.

2.5 EXIT SIGNS

- A. General Requirements: Comply with UL 924 and the following:
1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.
- B. Internally Lighted Signs: As follows:
1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.

- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - 1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically energizes lamp from unit when circuit voltage drops to 80 percent of nominal or below. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.6 EMERGENCY LIGHTING UNITS

- A. General Requirements: Self-contained units. Comply with UL 924. Units include the following features:
 - 1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.
 - 4. Wire Guard: Where indicated, heavy-chrome-plated wire guard arranged to protect lamp heads or fixtures.
 - 5. Integral Time-Delay Relay: Arranged to hold unit on for fixed interval after restoring power after an outage. Provides adequate time delay to permit high-intensity-discharge lamps to restrike and develop adequate output.

2.7 LAMPS

- A. Fluorescent Color Temperature and Minimum Color-Rendering Index: 3500 K and 75 or 82 CRI, unless otherwise indicated. Lamps shall be designed to pass the Federal TCLP test in effect at the time of manufacture.
- B. Noncompact Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid-start circuits.
- C. Metal-Halide Color Temperature and Minimum Color-Rendering Index: 3600 K and 70 CRI, unless otherwise indicated.

2.8 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 16 Section "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (12-mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

- C. Twin-Stem Hangers: Two, 1/2-inch (12-mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
- D. Rod Hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.9 FINISHES

- A. Fixtures: Manufacturer's standard, unless otherwise indicated.
 - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
 - 2. Metallic Finish: Corrosion resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.
- B. Suspended Fixture Support: As follows:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 - 4. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on Drawings.

3.2 CONNECTIONS

- A. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

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- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests: As follows:
 - 1. Verify normal operation of each fixture after installation.
 - 2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
 - 3. Verify normal transfer to battery source and retransfer to normal.
 - 4. Report results in writing.
- E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- F. Corrosive Fixtures: Replace during warranty period.

3.4 CLEANING AND ADJUSTING

- A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION 16511

SECTION 16720 - FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section of the specification includes the furnishing, installation, and connection of a new microprocessor-based addressable or hard-wired fire alarm system required to form a complete coordinated system ready for operation. It shall include, but not be limited to, fire alarm control, alarm initiating devices, alarm notification appliances, auxiliary control devices, integrated radio transceiver, antenna, power supplies, and wiring as shown on the drawings and specified herein. The system design is based on Monaco Enterprises, Inc., Spokane, WA.
- B. The fire alarm system shall comply with requirements of NFPA Standard No. 72 for protected premises signaling systems except as modified and/or supplemented by this specification. The system shall be capable of on-site programming.
- C. The system shall be an active type system where each device causes an LED signal to be transmitted to the Main Fire Alarm Control Panel (FACP) indicating that the zone and its associated circuit wiring is functional. Loss of this signal at the main FACP shall result in an LED and audible trouble indication as specified on the drawings or hereinafter for the particular zone.
- D. The system shall be provided with 24 VDC standby battery power capable of 60-hour life in supervisory mode and a final 10-minute alarm before shutdown. Battery system shall be auto-charged and trouble-monitored.
- E. The alarm system shall have the capability of recalling "in memory" alarms and trouble conditions in chronological order to recreate an alarm event history.
- F. The operation of any fire detection system or manual alarm shall automatically:
 - 1. Notify the Central Receiving Station.
 - 2. Sound an alert signal to all required locations.
 - 3. Activate the evacuation signal.
- G. The Control Panel shall include alarm verification operation for the smoke detector zones, which incorporates a 1-minute alarm verification. If no second alarm is received, the zone will reset automatically to normal mode. A verification second alarm will activate the alert system.
- H. A manual evacuation (drill) switch shall be provided to operate the alarm indicating appliances without causing other control circuits to be activated. A true alarm will override the test conditions.

- I. The Control Panel shall be served by a dedicated 120 Volt single-phase circuit. The 24 VDC alarm system shall automatically transfer to standby battery upon power failure.

1.2 RELATED WORK

- A. The work of this Section shall hereby include Section 16010 - Basic Electrical Requirements, Section 16050 - Basic Electrical Materials and Methods, Section 16721 – Fire Alarm Reporting/Receiving System.

1.3 REFERENCES

- A. The fire detection system shall be installed in accordance with the specifications, drawings, and the requirements of NFPA-72, National Electric Code 760 and in accordance with (ADA) American Disabilities Act.
- B. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.
- C. All conduit wiring and fire alarm equipment shall be wired as follows:
 - 1. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D).
 - 2. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z).
- D. Work of this section shall be coordinated with other contract work.

1.4 SUBMITTALS

- A. General:
 - 1. Submittals shall be submitted for review in accordance with Section 16010, Basic Electrical Requirements.
 - 2. All references to manufacturers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent equipment (compatible UL Listed) from other manufacturers may be substituted for approval as the specified equipment as long as the minimum standards are met and equipment is compatible with the design system.
 - 3. All substitute equipment proposed as equal to the equipment specified herein, shall meet or exceed the standards. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

B. Shop Drawings:

1. Sufficient information on the design system and equipment, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show annunciator layout and main control panel module layout with configurations and terminations.

C. Manuals:

1. Submit 10 complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets at completion of project in accordance with Section 16010, Basic Electrical Requirements.
2. Wiring diagrams shall indicate internal wiring for each item of fire alarm system equipment and the interconnections between the items of equipment.
3. Provide a clear and concise description of operation that provides the information required to properly operate the equipment and system.
4. The Contracting Officer acceptance and Government approvals will be based on complete submission and review of shop drawings.

D. Certifications:

Together with the shop drawing submittal, submit a certification from the successful bid equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification. Performance and operating system test shall be conducted in the presence of the Contracting Officer or his representative.

1.5 WARRANTY

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid. Manufacturer's material and service shall be available within a 50-mile radius.

1.6 POST CONTRACT MAINTENANCE

- A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative for a period of five (5) years after expiration of the guaranty. The manufacturer shall be prepared to offer a warranty contract beyond the one-year period.
- B. After system acceptance, provide the Government with a quote for a maintenance contract to provide all maintenance, test, and repair described below. Include also a quote for unscheduled maintenance/repair, including hourly rates for technicians trained on this equipment, and response travel costs. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for a five (5) year period after the expiration of the guaranty.
- C. Maintenance and testing shall be on a semiannual basis or as required by the local agent. A preventive maintenance schedule shall be provided which describes the procedures for preventive maintenance. The schedule shall include:
 - 1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panel, power supplies, relays and all accessories of the fire alarm system.
 - 2. Each circuit in the fire alarm system shall be tested semiannually.
 - 3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72.

1.7 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

A. National Fire Protection Association (NFPA):

No. 70	National Electric Code (NEC)
No. 72-1996	National Fire Alarm Code
No. 101	Life Safety Code

B. Underwriters Laboratories Inc. (UL):

No. 50	Cabinets and Boxes
No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 521	Heat Detectors for Fire Protective
No. 228	Door Closers-Holders for Fire Protective Signaling Systems.
No. 464	Audible Signaling Appliances.
No. 38	Manually Actuated Signaling Boxes.

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- No. 1481 Power supplies for Fire Protective Signaling Systems.
- No. 1076 Control Units for Burglar Alarm Proprietary Protective Signaling Systems.
- No. 1971 Visual Notification Appliances.

C. Local and State Building Codes - Authority Having Jurisdiction (AHJ).

D. Requirements of the American Disabilities Act (ADA).

1.8 APPROVALS

A. The fire alarm system must have proper listing and/or approval from the following nationally recognized agencies:

NFPA National Fire Protection Agency

UL Underwriters Laboratories Inc

FM Factory Mutual

B. Modular Labeling

The fire alarm control panel shall meet the modular listing requirements of Underwriters Laboratories Inc. To facilitate system changes and expansions, and to ensure that all subassemblies have the proper listing, each subassembly of the FACP shall carry the appropriate UL modular label. This includes, but is not limited to, all printed circuit board assemblies, power supplies, and enclosure parts.

1.9 QUALITY ASSURANCE

A. All fire alarm system products shall be those of a single manufacturer and bear the "UL" label. All control equipment shall be listed under UL Category "UOJZ" as a single control unit. Partial listing shall not be acceptable.

B. All control equipment shall have transient protection to comply with UL 864.

C. The manufacturer of the fire alarm system shall have a minimum of 10 years of successful installation experience.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL

A. All equipment and components for the system shall be new. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized

representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

- B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- C. All equipment shall be attached to walls and ceiling/ floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load with a minimum safety factor of 3.
- D. The Control Panel shall be expandable with solid-state microprocessor-based electronics. Keyboard or keypads shall not be required to operate the system during fire alarm conditions.
- E. A local audible device shall sound during alarm conditions. This audible device shall also sound upon any key press to confirm the key press is correct.
- F. The Control Panel shall use backlighted liquid crystal display for readable clarity. During AC outage, the display under battery power shall only be lighted for alarm or keyboard activity.
- G. The Control Panel shall be capable of operating all connected devices with 10% spare capacity.
- H. An "alarm silence" button shall silence all activated alarms, but retain an LED display until the system is reset.
- I. Alarm system reset shall require all alarm clearances and a procedure through manufacturer's reset process per the operations manual.
- J. The alarm system shall be capable of being tested by one person.
- K. All LED's shall be monitored for burnout or failure. Any LED problem shall be identified on the module to facilitate location and repair.
- L. The following primary controls shall be visible through the front access panel:
 - 1. Liquid crystal display
 - 2. Red system alarm - LED
 - 3. Yellow supervisory service - LED
 - 4. Yellow trouble - LED
 - 5. Green "Power On" - LED
 - 6. Alarm Acknowledge key
 - 7. Supervisory Acknowledge key

8. Trouble Acknowledge key
9. Alarm silence key
10. System reset key

2.2 CONDUIT AND WIRE

A. Conduit:

1. Conduit shall be installed in accordance with Section 16050, the National Electrical Code (NEC), local and state requirements.
2. All wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area per NEC where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.
4. Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
6. Conduit shall be 3/4 inch (19.1 mm) RGS minimum.

B. Wire:

1. All conductor and cable for the fire alarm system wiring must be new.
2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 14 AWG (1.63 mm) for notification appliance circuits.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR). No splices shall be allowed in conduit runs.

5. The system shall permit the use of IDC and NAC wiring in the same conduit with the multiplex communication loop.
 6. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring; a trouble signal will be activated until the system and its associated field wiring are restored to normal condition.
- C. Terminal Boxes, Junction Boxes and Cabinets:
1. All boxes and cabinets shall be UL listed for their use and purpose.
- D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.
- E. Door Holders and Electric Locks:
1. Door holders and electric locks shall be UL listed and shall interface with the alarm to release upon alarm activation.

2.3 SYSTEM COMPONENTS

- A. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and shall meet the following criteria:
1. The maximum pulse duration shall be 2/10 of one second.
 2. Strobe intensity shall meet the requirements of UL 1971.
 3. The flash rate shall meet the requirements of UL 1971.
 4. Strobe lights shall be synchronized with all other strobe lights and all audio/visual combination devices.
 5. Strobe lights shall be flush wall-mounted in new construction and wherever possible and surface mounted using manufacturer provided type "FS" backboxes in existing building where flush mounting is not possible.
- B. Audible/Visual Combination Devices:
1. Shall meet the applicable requirements of Section A listed above for audibility.
 2. Shall meet the requirements of Section B listed above for visibility.
 3. Audio/visual combination devices shall be synchronized with all other audio/visual combination devices and all strobe lights.

4. Audio/visual combination devices shall be flush wall mounted in new construction and wherever possible and surface-mounted using manufacturer provided type "FS" backboxes in existing building where flush mounting is not possible.
- C. Duct Smoke Detectors: Duct smoke detectors shall be a 24 VDC type and shall be furnished and installed under Division 15 and fire alarm wired under this Section. Associated remote test indicating stations shall be furnished under Division 15, but installed and fire alarm wired under this section.
- D. Waterflow Indicator:
1. Waterflow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type.
 2. Waterflow switches shall be fire alarm wired and connected under this section but furnished and installed under Division 15 by the fire protection contractor.
 3. Where possible, waterflow switches shall be located a minimum of one (1) foot from a fitting which changes the direction of the flow and a minimum of three (3) feet from a valve.
- E. Sprinkler and Standpipe Valve Supervisory Switches:
1. Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
 2. PIV (post indicator valve) or main gate valves shall be equipped with a supervisory switch.
 3. The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
 4. The supervisory switch shall be contained in a weatherproof aluminum housing, which shall provide a 3/4-inch (19 mm) conduit entrance and incorporate the necessary facilities for attachment to the valves.
 5. The switch housing shall be finished in red baked enamel.
 6. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.

7. Valve supervisory switches shall be fire alarm wired and connected under this section and furnished and installed under Division 15 by the fire protection contractor.

F. Pull Box (manual station)

1. All operated stations shall have a positive, visual indication of latch operation and utilize a key type reset. Pull stations shall be single-action-type and shall be UL listed.
2. Manual stations shall be constructed of high impact red Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger. Key operation shall be common with the Control Panel. No Allen key or special tools will be allowed.
3. Manual stations shall be flush wall mounted in new construction and wherever possible, and surface mounted using manufacturer provided type "FS" backboxes in existing building where flush mounting is not possible.

G. Photoelectric Smoke Detector

1. The detectors shall be solid state photoelectric (light- scattering) principal in measuring smoke density and use a refracted infrared LED light source with seals against rear air entry.
2. The detector shall fit into a base common to both heat and smoke-type detectors. Spare heads and bases shall be provided.
3. There shall be no limit to number of detectors which may be activated, "in alarm" simultaneously.

H. Thermal Detectors

1. Thermal detectors shall be devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute.

I. Annunciators

1. Annunciator shall be microprocessor solid-state design.

J. Audible/Visual Units (Xenon Strobes)

1. Audible/visible units shall include separate horn and Xenon flash tube units entirely solid state.

2. Visual units shall be solid state with Xenon flash tube construction in single gang, surface mount box. Minimum light output shall conform to ADA at 75 cd.
 3. Visual units shall be installed according to drawings, specifications, NEC and manufacturer's recommendations.
- K. Emergency Batteries and Cabinet
1. The emergency battery system shall be capable of maintaining the fire alarm operation in excess of 60 hours.
 2. Batteries, charger system and cabinet shall be the product of a single manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the equipment manufacturer.
- B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage. Fire alarm wiring shall not be installed with any power or lighting system conductors. Enroute splices or wire nuts are not allowed.
- C. All fire detection and alarm system devices shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- D. Wiring details shown on the drawings is approximate only and final wiring shall be based upon manufacturer's wiring diagrams, at no increased cost to the Government.
- E. The manufacturer shall provide complete one-line schematic wiring diagrams for all specified fire alarm systems.
- F. All equipment connected to alternating current circuits shall be protected by surge arresters for IEEE C62.41 and NFPA 70.
- G. The fire alarm system shall be connected to building ground per the manufacturer's instructions. Maximum readings to ground shall meet NEC requirements. A final reading of 5 ohms or less is recommended.

3.2 TYPICAL OPERATION

- A. Actuation of any manual station, smoke detector, heat detector or water flow switch shall cause the following operations to occur unless otherwise specified:
 - 1. Activate all notification circuits until silenced.
 - 2. Actuate all strobe units until the panel is reset.
 - 3. Annunciate the active initiating devices and zones.
 - 4. Release all magnetic door holders to doors to adjacent zones on the floor from that the alarm was initiated.
 - 5. Return all elevators to the primary or alternate floor of egress.
 - 6. A smoke detector in any elevator lobby shall, in addition to the above functions, return all elevators to the primary or alternate floor of egress.
 - 7. Smoke detectors in the elevator machine room or top of hoistway shall return all elevators in to the primary or alternate floor.
 - 8. Activation of any sprinkler system low-pressure switch, or valve tamper switch shall cause a system supervisory alarm indication.

3.3 TEST

- A. Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. The Contracting Officer and/or the Government shall be notified of the planned test date to complete their attendance.
 - 1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 - 2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
 - 3. Verify activation of all flow switches.
 - 4. Open initiating device circuits and verify that the trouble signal actuates.
 - 5. Open signaling line circuits and verify that the trouble signal actuates.
 - 6. Open and short notification appliance circuits and verify that trouble signal actuates.
 - 7. Ground initiating device circuits and verify response of trouble signals.

8. Ground signaling line circuits and verify response of trouble signals.
9. Ground notification appliance circuits and verify response of trouble signals.
10. Check presence and audibility of tone at all alarm notification devices.
11. Check installation, supervision, and operation of all intelligent smoke detectors during a walk test.
12. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the existing FACP and the correct activation of the control points.
13. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to confirm verifying controls performance on individually addressed or grouped devices, including sensitivity monitoring, location, verification and other alarm functions.

3.4 FINAL INSPECTION

- A. At the final inspection a factory-trained representative of the manufacturer of the major equipment shall demonstrate to the Contracting Officer and/or the Government that the systems function properly in every respect. The Government shall reserve the right of final approval.

3.5 INSTRUCTION

- A. Provide 8 hours instruction for 3 days on operating the fire alarm system. Hands-on demonstrations of the operation and maintenance of all system components and the entire system including program changes and functions shall be provided.
- B. The contractor and/or the systems manufacturer's representatives shall provide 10 copies of a typewritten "Sequence of Operation" to the Government for the installed fire alarm system.
- C. Coordinate all training sessions with the Government and/or the Contracting Officer.
- D. Training shall be conducted by technical personnel in the direct employ of the fire alarm manufacturer. A third party instructor shall not be acceptable.

END OF SECTION

SECTION 16721 - FIRE ALARM REPORTING/RECEIVING SYSTEM, RADIO TYPE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide Fire Alarm Radio Reporting/Receiving System, Radio Type.
- B. Remote monitor.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ELECTRONICS INDUSTRIES ASSOCIATIONS (EIA)

ANSI/EIA/TIA-222-F 1996 Steel Antenna Towers and Antenna Supporting Structures

FEDERAL STANDARD (FED-STD)

FED-STD-595 Colors Used in Government Procurement

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825 2000 Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C.62.41 1991 Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 1993 Enclosures for Industrial Controls and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 1999 National Electrical Code (NEC)

NFPA 72 1999 National Fire Alarm Code

UNDERWRITERS LABORATORIES, INC. (UL)

UL FPED 2000 Fire Protection Equipment Directory

UL 467 1994 (R 1986) Grounding and Bonding Equipment

UL 514A 1996 Metallic Outlet Boxes

UL 514B 1997 Fittings for Conduit and Outlet Boxes

UL 1242 2000 Intermediate Metal Conduit

1.3 GENERAL REQUIREMENT

- A. Standard Products: Materials and equipment shall be first grade, standard, current products of the manufacturer and shall be suitable for the performance of their separate functions. Where two or more pieces of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer. Material and equipment shall be standard products that essentially duplicate items that have been in satisfactory use for at least two years in projects similar in size and scope to this project. The Contractor shall identify installations where identical equipment is in service and shall provide names and telephone numbers of knowledgeable persons within the using facility.
- B. Nameplates: Major components of equipment shall have the manufacturer's name, catalog number and technical data as applicable on a non-corrosive and non-heat sensitive label affixed to the equipment.
- C. Verification of Dimensions: The Contractor shall become familiar with all details of the work, verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.
- D. Compliance: Installed systems shall be configured in accordance with NFPA Standard 72, Chapter 5-3 "Proprietary Supervisory Stations" except as modified or annotated herein. The system shall be listed by Underwriters' Laboratories, Inc. (UL), or approved by the Factory Mutual System (FM) or another nationally approved testing laboratory, as a radio fire alarm system.
- E. Qualifications of Installer: Prior to commencing work, the Contractor shall submit data showing that he has successfully installed radio fire alarm systems, or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor or the subcontractor referred to above, has installed such systems. The Contractor shall indicate these systems have performed satisfactorily in the manner intended for a period of not less than 18 months.
- F. Manufacturer's Representative: The Contractor shall provide the services of a factory trained and certified manufacturer's representative or technician, experienced in the installation and operation of the type of system being provided to supervise the installation, testing (including final testing) and adjustment of the system.
- G. Equipment shall be as manufactured by MONACO Enterprises, Inc., Spokane, WA.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTALS.

- A. Design Analysis and Calculations: Substantiating battery calculations, including ampere-hour requirements, shall be submitted for supervisory and alarm power requirements for:

1. Radio alarm transceivers
 2. Interface panels (if provided).
- B. Detail Drawings: Detail drawings shall be submitted and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts and installation instructions. In addition, the following drawings shall be provided:
1. Layout drawings of the entire system, showing location of all fire alarm equipment and devices.
 2. Wiring diagrams showing points of connection and terminals to be used.
 3. Interior wiring diagrams of each major system component.
- C. Manufacturer's technical data shall be provided as required to demonstrate that the system has been coordinated and will properly function as a unit. Data describing more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide. Partial submittals will not be accepted. Submit data for the following:
1. Radio alarm transceivers in each configuration required by this specification.
 2. Interface device, unless integral with transceivers.
 3. Antennas and cables.
 4. Power supplies, including batteries.
 5. Lightning protection devices.
- D. The Contractor's submittal shall be signed by a system designer who is regularly engaged in fire protection, detection and radio alarm systems and who has had at least two years of current experience in design of these systems.
- E. Upon completion of the installation and prior to final inspection, the contractor shall furnish 'as-built' drawings. In addition, the Contractor shall furnish copies as stated herein of manuals giving complete instructions for the operation, inspection, testing and maintenance of the system including wiring diagrams.
- F. Quality Assurance Plan: The Contractor shall furnish to the Contracting Officer detailed test procedures for the fire detection and alarm system 30 days prior to performing system tests.
- G. Test Reports: Upon completion and testing of the installed system, test reports shall be submitted in booklet form showing all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.
- H. Training Data: The Contractor shall provide a factory-trained, qualified instructor to conduct a minimum of 16 hours of training, to base personnel designated by the Contracting Officer, in the maintenance, troubleshooting, operation and programming of the furnished equipment. Training shall start after the system is functionally complete but prior to final acceptance tests.
- I. Installation Procedures: The installation of the system shall be in accordance with the manufacturer's published installation procedures and all applicable codes and standards referenced herein.

- J. Certificates of Compliance: Copies of the following shall be provided:
1. Current UL listings or FM approvals for the system in the configuration(s) offered.
 2. FCC Type Acceptance Grants.
 3. Name(s) of personnel who will supervise installation and testing of the system, and who will provide instruction to Government personnel, with the manufacturer's certification of the qualifications of the named individual(s).
 4. Certification of satisfactory operation of similar systems as described in the paragraph titled "Qualifications of Installer."
- K. Operating Instructions: The Contractor shall furnish the Contracting Officer 8 complete copies of operating instructions outlining step-by-step procedures required for system startup, operation and shutdown. Instructions shall include the manufacturer's name, model number, parts list, and a brief description of the equipment and its basic operating features. Operating instructions shall be submitted and approved prior to the start of the training course.
- L. Preventive Maintenance and Inspection: The Contractor shall furnish the Contracting Officer 8 copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring and control diagrams of the system. Maintenance instructions shall be submitted and approved prior to the start of the training course.

1.5 DELIVERIES AND STORAGE

- A. All equipment delivered and placed in storage shall be protected from weather, humidity, and temperature variations; and dirt, dust, and other contaminants.

1.6 SYSTEM OPERATION

- A. The radio system reports alarms and status changes to the Central Supervising Station. The system shall comply with NFPA 72, Chapter 5, Section 3. The system shall be connected to local building fire alarm systems, sprinkler water flow detectors, manual pull stations and extinguishing system control panels as shown herein and/or on the drawings. The system shall indicate the area of alarm and the radio link shall be supervised and operated using two-way data transmission in accordance with NFPA 72 Standards.

1.7 MONITORING FOR INTEGRITY

- A. All means of interconnecting equipment, devices and appliances, and wiring connections shall be monitored for the integrity of the interconnecting conductors or equivalent path, so that the occurrence of a single open or a single ground-fault condition in the installation conductors or other signaling channels, and the restoration of such a condition to normal, shall be automatically indicated within 200 seconds. This shall include antennas, coaxial cables and lightning arrestors (static discharge units).

1.8 G.S.A. AUTHORIZED SUPPLY SCHEDULE

- A. Manufacturer shall be a G.S.A. Authorized Supply Schedule Contractor.

1.9 FIRE ALARM REPORTING/RECEIVING SYSTEM

- A. Fire alarm reporting/receiving system shall be as manufactured by MONACO Enterprises, Spokane, WA.

PART 2 - PRODUCTS

2.1 RADIO FIRE ALARM TRANSCEIVERS

- A. Radio fire alarm transceivers shall be all solid-state and shall comply with all applicable portions of FCC Part 15 governing type acceptance. All radio fire alarm transceivers of a common configuration shall be interchangeable with the other devices furnished by the manufacturer. Each radio fire alarm transceiver, and interface device (if used), shall be the manufacturer's current commercial product completely assembled, wired, tested at the factory, and delivered ready for installation and operation. Radio fire alarm transceivers shall include a modular RF transceiver to allow a continuous interrogation/reply technique in which the transceivers are continually supervised by the Central Receiving Console. The interrogation/reply scheme shall be such that any equipment malfunction, which could prevent the transmission of alarm signals, will be recognized and reported at the Central Receiving Console within 200 seconds. The interrogation/reply technique shall also insure that any alarm from any system location will be reported to the Central Receiving Console within 90 seconds.
- B. Frequency Allocation: The specific operating frequency shall be assigned by the Contracting Officer, in consultation with the Area Radio Frequency Coordinator, within 90 days after submission of completed Application for Frequency Allocation following contract award. Transceivers shall be configured for operation on any selected frequency. Transceivers shall be single-channel synthesized, or multi-channel synthesized programmed to a single channel. The transceiver shall have a minimum frequency stability of 1.5 PPM (UHF).
- C. Radio Fire Alarm Transceiver Power Requirements: Each transceiver shall be powered by a combination of locally available 120 Vac power, and spill-proof, sealed lead acid or lead calcium battery requiring no addition of water or electrolyte. Operating power shall be obtained from a single connection to a dedicated, fused branch circuit of the building's regular 60 Hz ac service. Where a local energy fire alarm control panel is fed by the same arrangement, a common feed to both the local panel and the transceiver is permitted. In the event of loss of ac power, the transceiver shall automatically and instantaneously switch to standby battery power without loss of any alarm signals. Loss of ac power shall also activate an indicator and cause an ac failure message to be transmitted if power is not restored within 60 seconds. Power supply filtering shall prevent nuisance message transmissions caused by transient or steady state electrical disturbances. Upon restoration of ac power, transfer back to ac operation shall be automatic. Under presence of ac power, batteries shall be charged through a converter/float charge. The charger shall recharge a fully discharged battery in not more than 48 hours while the transceiver is operating under ac power. The battery and converter/battery charger shall be installed within the transceiver housing.

- D. Battery Power: The battery package shall be capable of supplying all power requirements of the transceiver.
- E. Battery Duration: Radio fire alarm transceiver standby battery capacity shall provide sufficient power to operate the transceiver in a normal standby status for a minimum of 60 hours and be capable of transmitting an alarm signal at the end of the period. Each radio fire alarm transceiver shall disconnect the standby batteries before the batteries are permanently damaged by excessive discharge.
- F. Battery Supervision: Each radio alarm transceiver shall constantly monitor and supervise its battery power supply. A Battery Fault message shall be transmitted when battery voltage under load falls below 85 percent of the rated battery voltage, but in any case prior to the point at which the battery will fail to operate the transceiver and before the low battery disconnect activates. A Battery Fault message will also be transmitted upon disconnection or removal of the battery supply, or charging system faults.
- G. Painting: Radio fire alarm transceiver housings, and interface housings, shall be factory painted with polyester powder-coat paint. The finish color shall be "Fire Engine Red." Painted surfaces damaged during installation shall be repainted to match the existing paint.
- H. Interfacing Indicators and Controls: Radio fire alarm transceivers shall incorporate provisions for interconnection to building alarm systems as defined in the paragraph titled "RADIO TRANSCEIVER INTERFACE DEVICE." At the manufacturer's option, all circuitry, switches and controls necessary to the functions required for radio fire alarm transceivers may be contained in one housing or in two separate housings. If two separate housing are utilized, all requirements for radio transceivers as stated herein remain in effect.
- I. Environmental Operating Requirements: Radio fire alarm transceivers shall be designed for reliable operation in an ambient temperature range of -30°C to $+60^{\circ}\text{C}$ (-22°F to $+140^{\circ}\text{F}$). Where required herein, standard model transceivers shall be provided in enclosures suitable for adverse climatic conditions including 100-mph winds, high humidity, ice, snow, and rain. Radio fire alarm transceivers with integral fire alarm control panel shall be designed for reliable operation in an ambient temperature range of 0°C to $+50^{\circ}\text{C}$ ($+32^{\circ}\text{F}$ to $+122^{\circ}\text{F}$).
- J. Lock: Internal components shall be protected from vandalism by a tamper-proof lock on the enclosure door. The housing shall allow access to all internal components for testing, servicing and replacement at the installation site. Locks for all transceivers shall be keyed alike.
- K. Mounting: Transceiver housings shall be designed for universal mounting on walls, light poles or pedestals. Mounting shall utilize lag bolts, anchor bolts, stainless steel banding, mounting brackets or a shackle/bolt combination, as applicable to the specific installation. Transceivers shall be installed in locations easily accessible for maintenance.
- L. Radio Fire Alarm Transceiver Housings: The housings on radio fire alarm transceivers shall be fabricated from protected metal conforming, as a minimum, to NEMA Standard 1 for indoor locations and NEMA 3R for exterior locations. Provision shall be made for conduit (minimum 3/4 inch ID) entry and attachment at no fewer than two places on the housing. Switches and other controls shall not be accessible without the use of a key.

- M. Generation of Signals: Each radio fire alarm transceiver shall provide for a prioritized transmission of all initiated signals; alarms shall always have reporting priority. The transceiver shall transmit all alarms, troubles and status changes at programmed intervals until receipt of the message is acknowledged via return message by the radio fire alarm Central Receiving Console.
- N. Power Output: The radio frequency (RF) power output of each radio fire alarm transceiver shall be a minimum of 4 watts or as required for reliable reception over long distances. Note: UHF frequencies between 450 to 470 MHz are limited to 2 watts maximum power output.
- O. Memory: Radio fire alarm transceivers shall have full memory capability. Simultaneous or subsequent actuation of any individual messages (from zones not initially in alarm), including those actuated during “off air” periods, shall not result in the loss of messages. Such messages shall be stored until they are successfully transmitted.
- P. Transceiver Identity Code: Each radio fire alarm transceiver shall transmit a distinct identity code as part of all signals emanating from the transceiver. The transceiver must provide the capability for setting the code or address in the field using no special tools. The identity code shall allow entry of up to four digits.
- Q. Message Designations: Each radio fire alarm transceiver shall allow as a minimum, or as required, no less than ten distinct and individually identifiable message designations as to the types or causes of transmitter actuation:
 - 1. Zone Messages: Zone messages shall be transmitted upon automatic or manual actuation of the transceiver input. The building and zone causing the actuation shall be individually identified by this transmission; each radio fire alarm transceiver shall be capable of transmitting as a minimum four unique alarm messages identifiable at the Central Receiving Station as fire or auxiliary type zones with a description of the zone. The transceiver shall also be capable of transmitting a trouble signal for each alarm zone. In addition, restoration of the zone input to normal shall result in a specific restoration signal being transmitted to indicate the return of the zone to normal supervisory condition.
 - 2. Test Message: Each radio fire alarm transceiver shall be capable of responding to automatic continuous or scheduled polls as well as manually activated system or individual transceiver polls. Where the schedule method is selected, automatic testing will occur at least once each 24 hours—at intervals of from one to 24 hours, selectable in one-hour increments—and the time(s) of occurrence shall be specified by the user. The Central Receiving Console CPU module clock shall regulate scheduled tests. Transceiver response to test messages shall include their current status including identification of all off-normal conditions.

3. **Tamper Message Designations** Each radio fire alarm transceiver shall provide for connection of an optional enclosure tamper and/or tilt switch and shall transmit a message automatically when the switch is activated. The message shall be identified as Tamper and shall include the transceiver identity code and building or location identification. The transceiver shall transmit an End of Tamper signal when the tamper switch is returned to the normal position.
4. **Trouble Message Designation** Each radio fire alarm transceiver shall provide automatic transmission of the following separate identifiable trouble messages:
 - a. **Zone Trouble Reported** if the transceiver input wiring is disarranged so as to compromise transceiver integrity or if the local building fire alarm system connected to the transceiver input signals a trouble condition. This message shall be identified by the building and zone in which the fault occurred. When the fault is corrected, the transceiver shall transmit an End of Trouble message with the same identification.
 - b. **AC Fail Reported** in the event that failure of the main operating power source of the transceiver has existed for 60 seconds. This message shall be identified by the transceiver identity code and building. When ac power is restored, the transceiver shall transmit an End of AC Fail message with the same identification.
 - c. **Battery Fault Reported** if the battery supply voltage under load falls below 85% of its rated voltage, or if the battery supply is disconnected from the transceiver, or if the battery charger voltage is high or low. This message shall be identified by the transceiver identity code and building. When the battery is recharged, replaced or reconnected, the transceiver shall transmit an End of Battery Fault message with the same identification.

2.2 RADIO TRANSCEIVER INTERFACE DEVICE

- A. Each radio fire alarm transceiver shall provide electrically supervised connections to local fire alarm control panels, sprinkler system flow devices and such other alarm and supervisory devices as indicated herein or on the drawings. Each transceiver shall provide electrical supervision for both open and ground conditions on interconnection wiring between the transceiver and a local fire alarm control panel, interface panel, or other alarm supervisory device. A ground fault condition or open condition in any of these circuits shall cause transmission of a trouble message identifying the affected zone. Where existing local control panels or devices do not provide isolated contact arrangements for transmission of alarm and trouble signals, an appropriate interface device will be provided to maintain system supervision in accordance with NFPA requirements. Where local fire alarm control panels do not provide a supervised alarm output for operation of interface panels, interface panels or devices shall be located within the local fire alarm panel or within three feet of the fire alarm control panel and all interconnecting wire shall be in conduit. Interface devices shall be completely assembled, wired and tested at the factory and delivered ready for installation and operation.
- B. **Enclosure:** When furnished as an independent, self-contained device, the interface device enclosure shall comply with paragraph 2.1.8.3.

- C. Indicators: Transceivers shall have alarm (red) and trouble (yellow) indicators to show the status of each reporting zone. Restoration of the alarm or trouble signals shall extinguish the associated zone indicator.
- D. Access: Switches and any other controls shall not be accessible without the use of a key. Access to controls shall be by unlocking and opening a panel or door.
- E. Mounting: When furnished as an independent, self-contained device, interface housings shall be designed for universal mounting on walls, light poles or pedestals. Mounting shall utilize lag bolts, anchor bolts, stainless steel banding, mounting brackets or a shackle/bolt combination, as applicable to the specific installation.
- F. Inputs/Outputs: Each radio fire alarm transceiver shall provide a minimum of four alarm circuit inputs (zones) for the purpose of connection to local fire alarm control panels, sprinkler water flow detectors, manual pull stations and extinguishing system control panels, utilizing Form A dry contacts. The specific zone quantities for each building shall be as shown and where additional zones are required they shall be provided.

2.3 RADIO FIRE ALARM MONITORING BASE STATION

- A. A radio fire alarm Central Receiving Console with compatible transceiver frequency meeting all requirements of section 2.1.1, Frequency Allocation, shall be provided. The system shall be completely assembled, wired and tested at the factory and delivered ready for installation and operation. The system shall utilize a Windows graphical user interface with Client/Server architecture and shall have at a minimum one Server operating continuously, interfacing to and servicing one or more Client applications as specified herein or shown on the drawings. Remote Client applications shall be capable of connection to the Server via a new LAN or WAN network. The system software shall be multi-user with an unlimited number of users, each with a unique Login name, password, and attributes. All data shall be maintained on the Server database with all Clients accessing the data as required for the operations conducted at the Client site.
- B. Receiver (Transceiver) System: The Central Receiving Console shall be a complete receiving system consisting of, but not limited to, dual receivers, dual transmitters arranged for operation on a 2:1 time basis, encoder/decoder, audible devices, visual display, digital clock, printer, primary and emergency power supplies, power supply monitors, memory devices and interconnecting cables. The radio fire alarm receiving system shall be complete and integrated and shall provide, as a minimum, the following components and functions or equivalent.

- C. Control Module: Radio Frequency (RF) Control Modules shall contain all required equipment to receive and decode signals from remote radio transceivers and shall include an RF transceiver to provide for continuous or timed interrogation/reply operation to remote radio transceivers. Two RF Control Modules shall be provided, each connected to an independent antenna system. RF Control Modules shall be supervised by the Central Server CPU Module and configured for automatic switching from one to the other. RF Control Modules shall be operated on a 2:1 time ratio basis within each 24 hours. Failure of an operating RF Control Module shall automatically result in transfer of system communications to the standby RF Control Module. Such failure will be annunciated visually and audibly, and printed on the system printer. Alarms shall have processing priority, and communication reliability shall be insured by two-way acknowledgment of all system transmissions and by error detection built into the message format.
- D. Fire Alarm Console: The Central Receiving Console shall receive, process, display and record emergency and non-emergency messages transmitted by the radio transceivers specified herein.
- E. Audible Device: The audible alarm signaling device used to indicate receipt of emergency messages shall produce a unique sound. The device shall be a component of the system and shall be activated upon receipt of all change-of-state signals. The sound used to indicate the receipt of transceiver/interface troubles shall be distinct from the sound used to indicate receipt of fire alarm/emergency messages. The system administrator shall have the ability to define the sound used to indicate alarm, trouble, and return to normal messages. The operator shall have the option of acknowledging an alert as a valid incoming signal or logging it as a test.
- F. Visual Display: The Central Receiving Console shall contain a Video Display Module consisting of a minimum 21-inch, non-interlaced high resolution, full color display. The input signal impedance shall be compatible with the graphics controller. Resolution shall be a minimum of 1280 horizontal by 1024 vertical format: the monitor shall operate in the SVGA mode. At a minimum, controls shall be provided for adjusting brightness and contrast, and degaussing. The monitor shall include internal speakers and microphone. The Video Display Module shall be controlled directly by the Central Server CPU Module.
- G. Console Memory: The Central Receiving Console shall have memory buffers in the RF Control Module (and all other communication interfaces) and in the Central Server CPU Module. The RF Control Module buffers shall provide for processing automatic interrogations and replies, automatic re-poll of non-responding transceivers, and retention of messages received until they are successfully communicated to the Central Server CPU Module. The Central Server CPU Module buffers shall provide for retention of a minimum of 55 messages that have not been acknowledged by the operator and a minimum of 55 active alarm and trouble displays. Buffers shall also be provided for information that is being downloaded to the printer. The system shall provide an alert for all received alarms; if an alarm does not match a transceiver/zone code stored in the system database, it shall be so identified. The system shall not provide an alert for any troubles that do not match codes stored in the database. All messages received from transceivers shall be printed on the printer log. Additionally, the Central Server CPU Module shall provide hard disk storage of historical and current data as described in paragraph 3.3.3.3 Incoming signals shall preempt any other Central Receiving Console (Central Server or Client Dispatch and Control Console) function and shall be processed, displayed, and printed.

- H. System Supervision: The Central Server CPU Module shall provide continuous supervision of communication with, and operating conditions of, the RF Control Modules and Printer. Individual status indicators shall be provided on each major component of the system. Additionally, the RF Control Module shall continuously supervise communication with the Central Server CPU Module and shall send messages received from radio fire alarm system transceivers to the Central Server CPU Module until the Central Server CPU Module signals receipt. An audible and visual alert shall occur in the event of any off-normal status of a major system component. All such alerts shall require operator acknowledgement. RF Control Modules shall be connected to the Central Server CPU Module, which performs all supervision as described above. When systems are provided with multiple RF Control Modules or Client Dispatch and Control Consoles, alerts for off-normal events must be displayed at the appropriate workstation. The system administrator shall be able to program where alerts for off-normal status shall be displayed.
- I. Receiver Supervision: The RF Control Module shall continuously supervise operation of its transceiver. Any failure of its capability to receive, transmit or encode/decode shall immediately produce an audible alert, a specific visual alert on the Video Display Module, a history log entry, and a printer log entry. Additionally, the Central Server CPU Module shall automatically transfer system communications to the standby RF Control Module. An audible and visual alert shall occur in the event that RF carrier on the operating frequency is detected continuously for longer than 15 seconds. The RF carrier must be absent for at least 15 seconds before a restore to normal is annunciated.
- J. Manual Battery Test: A means shall be provided to manually place the system on emergency battery power for test purposes.
- K. Electrical Connections: The Central Receiving Console shall be designed with modular components to allow interchange of components for maintenance purposes. All interconnecting cables and connectors shall be compatible with computer quality signal data transmission.

2.4 RADIO FIRE ALARM RECEIVING BASE STATION ANTENNA

- A. The Central Receiving Console shall be provided with an antenna system consisting of two complete antennas including a coaxial static discharge unit and an antenna grounding system, so that each of the dual transceivers is served by a separate antenna. The antennas shall be omnidirectional, minimum 3dB gain, vertically polarized and shall be provided with all necessary mounting brackets and supports for installation. The antennas shall be installed with a 36-inch minimum vertical separation at the receiving station and shall be located well away from overhead power circuits. Antennas shall be installed and grounded in accordance with the applicable portions of NFPA 70. Antenna supporting structures shall comply with applicable portions of EIA-222-E. Antennas for remote transceivers shall be vertically polarized with a driving point impedance of 50 ohms. The antennas may be omnidirectional or directional, as appropriate. All antennas shall be installed external to buildings and shall be located in accordance with manufacturer recommendations. Each transceiver shall have its own antenna; a single antenna shall provide for both transmitter and receiver operation of the transceiver. All antennas shall be provided with static discharge units (lightning arrestors) installed and grounded in accordance with the requirements of NFPA 70.

- B. Antenna Frequency Requirement Antennas shall be adjusted or designed to operate on the specified radio fire alarm system frequency.
1. Environmental Requirements All complete antenna assemblies shall be of corrosion-resistant materials and designed for reliable operation under adverse conditions including 100-mph winds, ice, snow, and rain.
 2. Antenna Cables Coaxial cables shall be 50 ohm RG type (or equivalent) with minimum 95% shield and shall include PL and BNC type fittings or connectors as appropriate.
- C. Grounding: Antenna masts and static discharge unit ground terminals shall be grounded in accordance with the requirements of NFPA 70, Article 810-21 and the manufacturer's instructions. Static discharge units and their enclosures shall be located inside the buildings as close as practical to the antenna lead-in point of entry. Ground rods shall not be utilized except where a suitable grounding electrode system does not exist. Where used, ground rods shall be of copper-clad steel conforming to UL 4561 not less than 5/8 inch in diameter by ten feet in length. Ground rods shall not protrude more than six inches above grade. Non-current-carrying metallic parts associated with new fire alarm equipment shall have maximum resistance to solid earth ground not to exceed the following values:
- | | |
|---------------------------------|---------|
| Antennas/static discharge units | 10 ohms |
| Radio alarm transceivers | 10 ohms |
- D. Communication Links: Cables and conductors, which serve as communication links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.
- E. Central Server Software: The Central Receiving System shall utilize Client/Server architecture as described above. The Server software shall utilize the Windows® NT 4.0 or Windows 2000 operating system. User access shall be password controlled with at least 32 levels of access rights provided. Central Receiving System software for complete operation and programming of the fire alarm receiving system shall be provided. All software shall be resident on the hard disk or other nonvolatile memory. Backup capabilities (ZIP drive, digital tape, or CD-RW) shall be provided so that the system can be completely restored in the event of hard disk failure/replacement. Central Receiving Server software shall include the following capabilities:
1. Geographical Information System (GIS) The system shall be a map centric design and shall utilize industry standard technology such as ESRI.
- F. History: The Central Receiving Server software shall automatically collate and retain history reports of zone alarms, zone and transceiver troubles, aircraft emergencies, non-zone emergencies, and apparatus dispatch actions as well as all operator actions related to automatic alarms received via RF Control Module or other Remote Interface Device.
- G. Reports: In addition to the standard reports provided with the system, a report generator such as Crystal Reports or Active Reports shall be provided with the system.

2.5 PRINTER

- A. The Central Receiving Console shall include an inkjet printer capable of printing 15 pages/minute at 1200 dpi x 600 dpi. The printer shall operate via a standard parallel port connection to the Central Server CPU Module. The printer shall automatically print all zone alarm, zone trouble, transceiver trouble and status change messages, including loss of communication to any or all remote units. Printouts will include time and date, and identification of the building, by number, from which the signals originated. The printer log shall also include operator actions such as acknowledging messages received and accessing the password.

2.6 POWER SUPPLY

- A. Primary operating power shall be single-phase 115 Vac, 60 hertz taken from the primary commercial power connection to the Central Supervising Station location. Primary power shall be suitably reduced, rectified and regulated as required by the equipment supplied. The central reporting equipment shall be provided with suitable transient protection that meets the requirements of ANSI C 62.41. Where the Central Supervising Station is provided with a secondary power source consisting of an emergency generator or other secondary power source in accordance with NFPA 72, the Central Receiving Console shall, in addition, be provided with a minimum of 15 minutes emergency standby power. This emergency standby power system shall be independent of any other power source within the Central Supervising Station. The power source shall consist of emergency standby batteries, fully automatic battery charger system, inverter (if required), and appropriate supervisory equipment to insure that the emergency power supply/battery system is functioning properly. In the event the Central Supervising Station does not have any appropriate secondary power source, the Central Receiving Console shall be provided with a standby power source consisting of batteries, charger, inverter (if required), and necessary accessories capable of operating the system for not less than 24 hours with maximum normal load and the primary power disconnected. The power supply shall provide adequate capacity to recharge the batteries and maintain them in a fully charged condition within 48 hours. The battery charger shall be fully supervised and shall provide indication of high and low charger voltages as well as missing battery. A visual and audible indication of "low battery" and "on battery" conditions shall be provided. The battery supply shall be continuously supervised. Switchover shall be instantaneous, shall in no way affect the operation of the system, and shall not result in loss of system database or parameters necessary for normal operation of the system.

2.7 CLIENT CPU MODULE

- A. A Client CPU Module shall be provided to control all operations of the Client Dispatch and Control Console as herein specified. The Client CPU Module shall be a minimum 933 MHz microprocessor-based Pentium III class computer with Windows NT 4.0 or Win2000/98/95 and shall include a minimum 20 gigabyte hermetically sealed hard disk, a minimum of 512 megabytes of random access memory, a minimum of one each 1.44 megabyte, 3.5" floppy disk drive, 40x CD ROM drive, sound card, 10/100 network interface card, mouse, PS/2 Win95 keyboard, a 21-inch, non-interlaced high resolution, full color display with an input signal impedance compatible with the graphics controller. Resolution shall be a minimum of 1280 horizontal by 1024 vertical format and the monitor shall operate in the SVGA mode. The system shall be designed such that operating software and system data shall be resident in nonvolatile memory such as hard disk, EPROM or NOVRAM. The Client Dispatch and Control Console shall provide a standard Windows user interface for all dispatching and control functions. The following functions and controls shall be provided as a minimum:

2.8 DISPATCH AND CONTROL CLIENT SOFTWARE

- A. Daily Activity Screen: The Daily Activity window shall include a system scheduler. This display shall be suitable for use as the primary viewing window and shall allow the system operator to create automatic scheduled control events (such as database backups, report printing, etc), reminders, and daily notes. These inputs shall be date driven with user input start and end dates for each item. The system shall also provide for response information access and display by manual recall, for zone and non-zone emergencies. The user shall be able to access various database viewers (personnel, hydrants, system status, resources, graphics, map and Hazmat by clicking on an identifying ICON. The system shall provide built in links to a third party EMS database such as Lighthouse and an identifying ICON shall be provided for access to this database. The EMS database software is not part of this contract and will be user supplied. The system shall provide built in links to an aircraft database and an identifying ICON shall be provided for access to this database. The system shall allow the operator to manually create an incident, enter the remote unit command screen, print reports or change operators by clicking on an ICON. All operator actions associated with events or system programming or configuration shall be permanently date/time stamped, printed and recorded in the system log.
- B. Incident Response Screen: The Client shall provide a dispatch information/display system that can access data stored on the Central Server, display status information, and automatically recall and display dispatch information by zone (or addressable point) upon receipt of alarm or trouble transmissions. Every automatic and operator initiated event shall be annunciated at the Client Dispatch and Control Console by a color-coded alert window. This window shall indicate the source and type (fire, security, E911, etc.) of the event. The operator shall have the capability to log the event as a test or acknowledge the event and create an incident. Each incident shall be automatically assigned a unique identifying number. A display will be provided that indicates the number of open (working) incidents as well as unacknowledged events. Once the event has been acknowledged, the operator shall have access to the following information by clicking on the specific incident and then the appropriate ICON.

- C. Dispatch: All resources identified for first response shall be listed in a window. The current status and location of each resource shall also be listed. The operator shall be able to list all resources (not just those associated with the incident location). Resource status (available, responding, en route, on scene, out of service, etc.) shall be annunciated visually by color-coding. The system shall allow the operator to input incident related notes upon completion of the incident. These notes shall be date/time stamped.
- D. Event Log: All incidents, events and actions will be time stamped and placed into permanent history. Standard reports in accordance with paragraph 3.9 shall be included to provide access to this data.
- E. Preplan Information: Preplan information shall be available by clicking on the appropriate ICON. This information shall be presented in a selectable standard format. The system administrator shall be able to create custom templates for the preplans using tools provided with the Central Server software. Preplan information may include, but not be limited to, location information, response instructions, water supply information, installed system description, special features, hazards/precautions, and comments.
- F. Remote Commands: The operator shall have immediate access to the remote unit command window by clicking on the appropriate ICON from any window. The Remote Commands window shall allow the operator to interrogate or download zone status, or command relay activate/deactivate by unit or group.
- G. Automatic and Manual Tests: The system shall allow the operator to manually interrogate any or all remote transceivers at any time. The Client CPU Module shall instruct the Central CPU Module to perform such interrogations as are selected by the user. Received transmissions of off-normal conditions will be automatically logged into history and recorded on the system printer.
- H. Activating of Remote Site Relays: The system operator shall be provided means of initiating manual RF signals to activate relays in radio fire alarm transceivers so equipped. The system shall also provide a means to automatically activate these relays upon receipt of automatic alarms.
- I. Setting the Time and Date: The system shall allow the operator to reset the time and date information. This information shall be continuously displayed on the visual display and shall be included on all printouts. All time/date changes, including operator identification shall be logged into history.
- J. Identifying the Operator on Duty: The system shall require the operator to enter his/her name or other identification, which will be continuously displayed on the visual display. The system operator on duty shall be identified in applicable log entries.
- K. Radio Fire Alarm Transceiver Status: The system shall be capable of providing a report of the status of all or individual remote transceivers. The operator may choose to display the report on the Video Display Module or print the report on the system printer.

- L. Reports: Zone and transceiver histories may be selected by the operator for individual units or all units of a type, and may be sorted for alarms, automatic or manual initiation, or troubles. Histories may be selected for any user-entered period. The operator shall have the option of sending the report to the Video Display Module or the Printer. The system shall have standard reports to include but not necessarily be limited to: system status, daily activity log, history (system alarms, specific remote unit, specific zone, all system activity, troubles, etc.), and incident history/log.
- M. Status Reports: At a minimum, the Central Server software shall automatically maintain a status of current alarms and troubles, current transceiver status including those in a no reply status, interface device status, and current resource status. This information shall be made available to the operator via the standard reports listed in paragraph 3.5.9. In addition, the system shall provide a means for exception reporting to provide a quick display of off normal conditions.
- N. First Responder Hazmat: The Central Receiving Console software shall incorporate the Department of Transportation Emergency Response Guidebook hazardous materials with their ID and guide numbers. The Guides and Initial Isolation and Protective Action Distances shall be included in the software. The Dispatch and Control Client software shall allow the user to enter additional hazardous materials and information specific to the installation. All such information added shall be stored on the Central Server and shall be accessible to all authorized Dispatch and Control Clients. The Dispatch and Control Client shall provide for manual display of response information for hazardous material incidents. Capability shall be provided for the user to attach hazardous materials to zone, aircraft and emergency alarm screens and to enter status, container type, and quantity specifically for each hazardous material in that particular building/zone, aircraft or emergency situation. These attachments shall be automatically displayed during an alarm condition. A means shall be provided for display of the Guide and selection of the specific emergency section of the Guide. The system shall have the capability to simultaneously operate a countdown timer for each active hazardous material alarm.

2.9 RADIO FIRE ALARM SYSTEM PERIPHERAL EQUIPMENT

- A. Radio Fire Alarm Transceiver Antenna: Antennas shall be vertically polarized with a driving point impedance of 50 ohms. The antennas may be omnidirectional or directional, as appropriate. All antennas shall be installed external to buildings and shall be located in accordance with manufacturer recommendations, well away from overhead power circuits. Antennas shall be of corrosion-resistant materials and designed to withstand wind velocities of 100 mph. Each transceiver shall have its own antenna; a single antenna shall provide for both transmitter and receiver operation of the transceiver. All antennas shall be provided with static discharge units (lightning arrestors) installed and grounded in accordance with the requirements of NFPA 70.
- B. Antenna Cables: Coaxial cables shall be 50 ohm RG type (or equivalent) with minimum 95% shield and shall include PL and BNC type fittings or connectors as appropriate.
- C. Conduit: Conduit and fittings shall comply with UL 6, UL 1242 and UL 797.

- D. Ground Rods: Where used, ground rods shall be of copper-clad steel conforming to UL 4561 not less than 5/8 inch in diameter by ten feet in length and shall be bonded to the building grounding electrode system in accordance with the requirements of NFPA 70.
- E. Power Supply: Operating power shall be as specified elsewhere in this document.
- F. Wiring: Wiring shall be in accordance with NFPA 70 and as follows: wire for branch circuits shall be 12 AWG solid copper minimum; wiring for signaling circuits shall be 18 AWG minimum, type FPL or equivalent type listed or approved for fire alarm system installations. All station wiring shall be color-coded.
- G. Graphic Display System: A complete Graphic Display System shall be provided as specified herein and shall be fully integrated with the Central Server Software. The Graphics Display System shall utilize hardware supplied as part of the Central Server CPU and/or the Client Dispatch and Control Console. No additional hardware shall be required for the Graphic Display System.
- H. Graphic Display System Functions: The Graphic Display System shall provide all software necessary to create, modify, store, and display vector-type graphic displays such as base maps, site drawings, building layout drawings, and individual aerospace vehicle (aircraft) emergency rescue procedures and pictographs and imported raster-type graphic displays such as user supplied scanned photo images.
- I. Graphic Display System and Receiving System Interface: The Central Receiving Console shall be configured to allow selected graphics to be automatically displayed upon receipt of incoming alarm signals on the Client Dispatch and Control Console. The graphic(s) shall be accessible by clicking a Graphics ICON. The system shall support up to two Video Display Modules allowing simultaneous display of graphics and dispatch information display on the Client Dispatch and Control Console Video Display Modules. The system software shall allow graphic displays to be assigned to each reported zone and to each aircraft and emergency alarm defined in the Central Server Software database. The systems shall also provide the capability for manual display of graphics by clicking on the Graphics ICON and clicking on the chosen graphic.
- J. Graphic Display System Hardware: All hardware necessary to utilize the Graphics Display System shall be provided as part of the Central Server CPU Module. A Graphics Display System that requires a separate CPU Module is not acceptable. Provide 1 2 Video Display Module(s) as described in Section 3.3.2.2 for use with Graphics Display System.

- K. Graphic Display System Software: The Graphic Display System software package shall support a minimum of 5000 graphics, limited only by available hard disk storage space. Each graphic may be attached to all zones, aircraft, or emergency displays to which it applies. The first graphic attached shall be displayed automatically upon receipt or input of an alarm at the Client Dispatch and Control Console. A list of all graphics attached to the zone in alarm shall be listed on the same display as the actual graphic display. The system shall be capable of displaying the other attached graphics for that zone, aircraft, or emergency upon selection by the operator at the Client Dispatch and Control Console. As a minimum, the system shall support graphics in the following formats: .jpeg, .dxf, .tiff, .bmp, .mpeg and gif. Graphics shall be accessible by clicking on the appropriate ICON. A Floor Plan ICON shall be provided on the incident screen to provide access to the floor plan for the incident location. The floor plan shall provide a color-coded real time zone/point status display. The user is required to supply all graphics user in one or more of the above listed formats. Contractor shall request, in writing, all user supplied graphics a minimum of 45 days prior to the date they are to be incorporated into the system. Maintenance of graphics following system acceptance shall be the user's responsibility.
- L. User-Created Graphics: The Graphic Display System shall include, as a minimum, AutoCAD LT 2002 CAD drawing software that will allow the user to create full-color graphic displays. The Graphic Display System software shall provide menu-selectable access to the drawing software and to related functions. The software shall also provide for importing and modifying drawings created in other compatible computer-aided drawing programs on other machines. The Graphic Display System software shall utilize Windows NT/2000 standard utilities for copying graphics from a variety of physical media such as CD-ROM, ZIP Drive, or floppy drive, to or from the hard disk.
- M. Graphic Real Time Display: The Graphic Display System shall provide a means of displaying the building layout and shall provide a real time display of zone/point status.
- N. Map Display System: A complete Map Display System shall be provided as specified herein and shall be fully integrated with the Central Server Software. The Map Display System shall utilize hardware supplied as part of the Central Server CPU and/or the Client Dispatch and Control Console. No additional hardware shall be required for the Map Display System.
- O. Maps: The system shall support a minimum of one map per site in ESRI shape file format. All maps to be utilized in the map display system shall be provided by the user. Should the user be unable to provide the map in the proper format, the contractor shall provide the capability to convert the user's map into the proper shape file format under separate contract. Updates to the map are the user's responsibility. Map Display System Functions.
- P. Map Display Software: The Map Display System shall provide all software necessary to provide a Geographical Information System (GIS) with the functionality described herein. This system shall be fully integrated with the Central Server Software and shall utilize the same database. The system shall utilize industry standard GIS technology such as ESRI and shall provide the capability stated herein. The incident display shall incorporate the GIS technology with the incident location centered on the screen and the view zoomed in to a user specified level. The operator (with appropriate security access) shall be able to identify and change the active layers on the map display in order to focus quickly on specific information (power lines, electrical lines, etc.).

- Q. The system shall provide information access and system control directly from the map. The operator shall be able to determine the status of a building's transceiver, sensors (fire, security, etc.) by clicking on the building shown on the map. Remote commands as described previously shall be accessible by clicking on the building shown on the map.
- R. Map Display System and Receiving System Interface: The Client Dispatch and Control Console and associated Map Display System shall be configured to utilize a map for the primary display screen. An alert may be automatically displayed upon receipt of incoming alarm, trouble, or supervisory signals on the Client Dispatch and Control Console. The location of the event shall be highlighted by a color coded ICON centered on the display. The operator shall have access to all information related to the incident (preplan, dispatch, and response data) by clicking on the incident ICON. This related information shall be displayed on the second Video Display Module if provided as part of this contract. The Map Display shall provide the means to assess the status of the complete reporting system by use of color-coded icons to represent alarms, troubles, supervisory, and other monitored status.
- S. Map Display System Hardware: All hardware necessary to utilize the Map Display System shall be provided as part of the Central Server CPU Module. A Map Display System that requires a separate CPU Module is not acceptable. Where required herein, a second Video Display Module as described in Section 2.3.2.5 Visual Display shall be provided for use with the Map Display System.

2.10 REMOTE MONITOR

- A. Remote monitor shall be completely compatible with Central Receiving Station equipment, complete with all necessary equipment, power supplies, antenna, surge suppression, etc.
- B. Remote monitor shall be a remote-signaling system that provides alarm and trouble information.
- C. System shall receive data from Central Receiving Station through a dedicated telephone line and display it on a video terminal.
- D. Communication driver I/O card.
- E. System shall be MANCO Enterprises, Inc., Spokane, WA, D-700 Series.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All work shall be installed as shown and in accordance with the manufacturer's recommendations, unless otherwise specified. Electrical work shall be in accordance with NFPA 70.

- B. Continuity of Protection: During the installation of this system, there shall be no loss of function of the existing base fire alarm system, or of the local building alarm systems connected thereto. Transfer of local alarm system connections from the existing base alarm systems shall not result in loss of alarm transmitting or receiving capability. Temporary interruption of individual building alarm connections, not to exceed eight hours duration, will be permitted at the discretion of the Contracting Officer.
- C. Power Supply for the System: A single branch-circuit connection for supplying power to the fire alarm system shall be provided. The backup power supply shall be automatically energized upon failure of the normal power supply.
- D. Wiring: Wiring shall be installed in rigid conduit, intermediate metallic conduit or electrical metallic tubing. The conductors for the fire alarm system shall not be installed in conduits, junction boxes or outlet boxes with conductors of lighting and power systems. The sum of the cross-sectional areas of individual conductors shall not exceed 40 percent of the interior cross-sectional area of conduit. Ample gutter space to accommodate all wiring shall be provided. Coaxial cables for antennas shall be installed entirely within minimum 3/4-inch conduit and shall not be installed with any other system conductors other than ground conductors.
- E. Overvoltages And Surge Protection

3.2 POWER LINE SURGE PROTECTION

- A. All equipment power supplies shall be protected from power line surges in accordance with IEEE C62.41 Category B. Fuses shall not be used for surge protection.

3.3 GROUNDING

- A. Antenna masts and static discharge unit ground terminals shall be grounded in accordance with the requirements of NFPA 70, Article 810-21 and the manufacturer's instructions. Static discharge units and their enclosures shall be located inside the buildings as close as practicable to the antenna lead-in point of entry. Where used, ground rods shall not protrude more than six inches above grade. Noncurrent-carrying metallic parts associated with new fire alarm equipment shall have maximum resistance to solid earth ground not to exceed the following values:

Antennas/static discharge units	10 ohms
Radio alarm transceivers	10 ohms
Interface panels	10 ohms

3.4 TESTING

- A. The Contractor shall notify the Contracting Officer ten days before the performance and acceptance tests are to be conducted. The tests shall be performed in the presence of the Contracting Officer or designated representative and under the supervision of the fire alarm system manufacturer's factory-trained and -certified representative. The Contractor shall furnish all instruments and personnel required for the tests.

- B. Performance Testing: Upon completion of the installation, the Contractor shall subject the system to a complete functional and operational performance test. This test shall determine that the system is free from grounded or open circuits. When all corrections have been made, the system shall be retested to assure that it is functional. Copies of performance test reports shall be submitted in accordance with section titled "SUBMITTALS."
- C. Acceptance Test: The test shall be in accordance with applicable requirements of NFPA 72, Chapter 7, and shall verify that all previous deficiencies have been corrected. The test shall include the following:
 - 1. Tests to indicate that there are no grounded or open circuits.
 - 2. Tests of each radio alarm transceiver function.
 - 3. Tests of radio fire alarm Central Receiving Console for all required functions.
 - 4. Tests of normal and emergency power supplies.
 - 5. Tests of each antenna system, maximum VSWR = 1.5:1

END OF SECTION